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enough credit to a translator to acknowledge his full share in such a work as this, a share that is most burdensome, and too little appreciated as a rule. English and American readers are certainly most grateful to Professors BALFOUR and GROOM for making accessible not only this new ecological treatise, but the other great ecological masterpiece as well, SCHIMPER'S *Plant geography.*—H. C. COWLES.

**Pharmakognostischer Atlas.**—KOCH[3] has followed his *Mikroskopische Analyse der Drogenpulver* with a second part for the use of apothecaries, wholesale druggists, sanitary officials, students of pharmacy, etc. In the arrangement of the text the author has followed his old scheme of different types, numerals, and indentations for greater facility in locating the various histological structures. Each drug has careful outlines on its preparation for microscopical observation and detailed descriptions of the individual tissues. Excellent plates of transverse and longitudinal sections serve to make these descriptions remarkably clear. The first *Lieferung* is devoted to cascarilla, red cinchona, and cinnamon barks. The complete work will certainly be useful in the recognition of crude drugs.—K. G. BARBER.

**Methods in microscopy.**—The second edition of the *Praktikum* of MÖBIUS[4] has about the same scope as the first. Directions are given for making preparations and also for some study of the preparations. Only the simplest methods are given, no attention being paid to the paraffin method or to critical methods of staining; in fact, most of the directions, in American schools, would be given orally or would be written on the blackboard for elementary classes which have no need as yet for any complicated technic. Of the 123 pages, 92 are devoted to spermatophytes, 6 to pteridophytes, 5 to bryophytes, and 20 to thallophytes. —CHARLES J. CHAMBERLAIN.

## NOTES FOR STUDENTS

**Genetics.**—In the fourth report to the Evolution Committee of the Royal Society, BATESON, SAUNDERS, and PUNNETT[5] present an account of their further studies with poultry, sweet peas, and stocks. Valuable summaries are given of all the studies that have been made on these subjects, the most interesting feature being the further evidence of the occurrence of such ratios as 7:1:1:7 and 15:1:1:15. It is suggested that the types of gametic coupling evident in cases of this kind might explain the occurrence of certain aberrant forms which are generally looked upon as mutants. The term "spurious allelomorphism" is proposed for the phenomenon of repulsion between two dominant factors or units, as for example when blueness and the erect standard in peas cannot be combined in the same individual, but are found to repel one another. The further work with stocks has mainly had reference to the phenomenon of doubling. The doubled stocks are always completely sterile and cannot be used for breeding purposes, so that it is not easy to determine the significance of this phenomenon. It is found that single stocks are of two kinds, one of which breeds true to the single, the other of which always throws a certain proportion of doubles when mated with its own kind, and the conclusion is drawn that this second type of single stock is perhaps a heterozygote in which the single character is dominant to the double. In stocks a difference is also found in the constitution of the pollen grains and ovules on the same plant. The presence and absence hypothesis is definitely accepted, and Miss DURHAM[6] in another paper appended to the report shows that on the basis of "presence and absence," the difficulties which CUÉNOT had found in certain mouse crosses completely disappear.

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[3] KOCH, LUDWIG, Pharmakognostischer Atlas. I, Die Rinden. I Bd. 1 Lief. pp. 26. *pls. 5.* Leipzig: Gebrüder Borntraeger. 1909. *M* 3.50.

[4] MÖBIUS, MARTIN, Botanisch-mikroskopisches Praktikum für Anfänger. Second edition. 8vo. pp. ii + 123. Berlin: Gebrüder Borntraeger. 1909. *M* 3.20.

[5] BATESON, W., SAUNDERS, MISS E. R., AND PUNNETT, R. C., Experimental studies in the physiology of heredity. Reports to the Evolution Committee of the Royal Society 4: 1–40. 1908.

In a discussion of the "presence and absence" hypothesis the reviewer[7] has shown that the absence of a character may be dominant over its presence quite as well as the reverse. A simple experiment to illustrate this among the other salient features of Mendelian inheritance has also been described.[8]

He has also published the results[9] of his investigation into the elementary species and hybrids of *Bursa Bursa-pastoris* and *B. Heegeri*, showing that the leaf characters of four elementary forms which were found in nature behave in the typical Mendelian fashion on crossing with one another. The same relation is found to exist between *B. Bursa-pastoris* and *B. Heegeri* that exists among the several elementary components of the former species, thus giving new proof of the derivation of the latter species from the former. However, the *Heegeri* type of capsule which disappears in the first generation of the hybrids reappears in the second generation in a ratio of about 22:1. The important feature of these results for evolution is the fact that four pure-breeding elementary species of *B. Heegeri* resulted from the cross, when only one had been found before.

CORRENS[10] has studied variegation and yellow-green foliage in Mirabilis, Urtica, and Lunaria, in which he shows that the yellow-green form, which he calls *chlorina*, and the white-margined variety or *albo-marginata* are Mendelian in their hereditary behavior, both these forms being hypostatic to green and the *chlorina* hypostatic to *albo-marginata*. Two variegated varieties of *Mirabilis Jalapa*, on the other hand, give quite unexpected results. It appears that the offspring is more or less dependent upon the character of the particular branch upon which the seed was produced. BAUR[11] has found a similar behavior in the white variegated Pelargonium; thus the offspring of a pure white branch gives nothing but pure white seedlings which are incapable of successful growth, while the offspring of pure green branches produce only pure green seedlings. BAUR goes into the anatomy of the white-margined varieties, and shows that there is a complete chlorophylless sheath overlying the chlorophyll-bearing tissues, and extending beyond them at the margin. BAUR'S theory for the production of such variegated varieties is that the yellow and chlorophyll-bearing plastids are distributed into the two daughter cells at each cell division, and by chance occasionally only nonchlorophyll-bearing plastids are included in one of the daughter cells. Thereafter this white cell gives rise to a cell progeny containing no chlorophyll and thus forming a white patch or streak which is the product of this one cell. When the division is anticlinal the variegation is in blotches, and when periclinal the white tissue becomes either median or marginal, only one case of the median type having been observed. BAUR'S results seem to indicate that the male germ cells, as well as the female, contribute characteristic plastids to individuals produced by their union, but this has not yet been actually observed.

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[6] DURHAM, FLORENCE H., A preliminary account of the inheritance of coat-color in mice. Reports to the Evolution Committee 4:41–63. 1908.

[7] SHULL, G. H., The "presence and absence" hypothesis. Amer. Nat. **43**:410–419. 1909.

[8] ———, A simple chemical device to illustrate Mendelian inheritance. Plant World **12**:145–153. 1909.

[9] ———, *Bursa Bursa-pastoris* and *Bursa Heegeri:* Biotypes and hybrids. Carnegie Institution of Washington, Publ. 112. pp. 57. *figs. 23. pls. 4.* 1909.

[10] CORRENS, C., Vererbungsversuche mit blass (gelb) grünen und buntblättrigen Sippen bei *Mirabilis Jalapa, Urtica pilulifera,* und *Lunaria annua.* Zeitschr. Abstam. Vererb. **1**:291–329. *figs. 2.* 1909.

The possibility that different parts of a plant may present different hereditary qualities, as shown by CORRENS and BAUR in these variegated varieties and as very generally recognized in the case of the relatively infrequent vegetative mutations known as bud-sports, is considered a matter of considerable importance by DE LOACH,[12] who seems to have found that in certain cotton hybrids some capsules of the heterozygote have the characters of the one or the other parent practically "fixed," while others give a large degree of splitting. Such suggestions as this open up interesting fields for investigation, but theoretically it does not seem likely that different parts of the same individual plant can *generally* have its own special type of heredity.

EMERSON[13] brings together the work that has been done in the study of Mendelian characters of beans, and finds that all evidence now at hand supports the reviewer's statement that in certain varieties of beans a unit character for mottling is present, which produces an external manifestation only when in the heterozygous state. EMERSON concludes that there are two distinct and unrelated units for mottling, one of which is a typical Mendelian dominant, the other becoming evident only in the heterozygous state, and on this basis he works out the expectation of various types of crosses. It remains to be demonstrated by actual breeding that such peculiar ratios may exist as 11:5, 21:38, 33:15, 16, etc.

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[11] BAUR, E., Das Wesen und die Erblichkeitsverhältnisse der "Varietates albomarginatae Hort." von *Pelargonium zonale*. Zeitschr. Abstam. Vererb. **1**:330–351. *figs. 20*. 1909.

[2] DE LOACH, R. J. H., The Mendelian and DeVriesian laws applied to cotton breeding. Georgia Experiment Station, Bull. 83:43–63. *figs. 7*. 1908.

[3] EMERSON, R. A., Factors for mottling in beans. Annual Report American Breeders' Association **5**:368–376. 1909.

A number of more or less popular expositions of Mendelism have appeared, and it is not necessary to mention these except in case new scientific matter has been used by way of illustration. One of the best of these general discussions is that of BAUR,[14] in which the illustrative material is almost entirely derived from his own experiments with *Antirrhinum majus*. In this species 15 or more different hereditary units have been demonstrated, and the author inclines to the view that much of so-called fluctuating variation is really Mendelian splitting of less prominent unit characters. The number of demonstrated units in this species exceeds the number of chromosomes, which leads the author to the conclusion that whole chromosomes cannot be the units upon which these characters depend. BAUR adheres strictly to the presence and absence hypothesis. SPILLMAN,[15] in a review of BAUR's paper, shows that so far as yet demonstrated the individual chromosomes may be the fundamental bases of these unit characters, although several instances are known in which the number of demonstrated unit characters in a species is in excess of the known number of chromosomes. The crucial test must be the finding of an *individual* having more independent characters than it has chromosomes. This has not yet been done.

DARBISHIRE[16] has once again repeated one of MENDEL's original experiments in order to determine whether there is any influence of pre-parental ancestry upon the offspring, a question involving the essential difference between the Mendelian and Galtonian conceptions of heredity. It was well that this experiment should be undertaken by one who was in the beginning a staunch Galtonian. The result of the experiment leads DARBISHIRE to the conclusion that "there is nothing like ancestral contribution within the limits of a single unit character," or in other words that segregation is perfect and the recessive character appears in as large a proportion of the offspring of a heterozygote after six generations of selection to the dominant character as in the $F_2$.

The Mendelian theory of heredity has produced a very deep impress upon the practical work of plant and animal breeding, and a considerable number of papers have appeared from economic sources which present valuable additional data in support of this theory, and indicating the extent of its applicability. Only a few of the more important of these papers can be noted here. Besides the paper of DE LOACH already mentioned, which shows that Mendelian behavior occurred in a certain cotton hybrid, BALLS[17] has discussed cotton hybrids in a comprehensive way, showing that at least 21 characteristics of the cotton plants behave as unit characters. BALLS declares that, while he does not know the exact number of chromosomes in the cotton nucleus, there are certainly not over 20, thus placing cotton with Pisum and Antirrhinum, as species in which the number of known unit characters exceeds the number of chromosomes. SUTTON[18] has carried on extensive crossings in Brassica and found that in a cross between the Swede turnip and the Ragged Jack kale there is a strict Mendelian behavior in which two unit characters are involved, namely, the fleshy character of the root and the curled leaves. The ratio of 9:3:3:1 appeared very clearly in the reciprocal hybrids of the cross. The glabrous-leaved brassicas (*B. oleracea* and its allies) would not cross with the hispid-leaved species (*B. rapa*, *B. campestris*, etc.), and crosses between the turnip and Swede turnip were sterile.

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[14] BAUR, E., Einige Ergebnisse der experimentellen Vererbungslehre. Beih. medizinischen Klinik **4**:265–292. 1908.

[15] SPILLMAN, W. J., The nature of "unit" characters. Amer. Nat. 43:243–248. 1909.

[16] DARBISHIRE, A. D., An experimental estimation of the theory of ancestral contributions in heredity. Proc. Roy. Soc. London B **81**:61–79. 1909.

NILSSON-EHLE[19] maintains that practically all of the supposed mutants if not all which have been found in wheat, oats, and other similar grains split after the Mendelian fashion, and are in reality the results of occasional cross-fertilizations, i. e., of "vicinism." The most important result reported by NILSSON-EHLE is the finding of several instances in wheat and oats, in which apparently identical external characters are produced by the presence of two or more independent units, thus resulting in the $F_2$ ratios 15:1, 63:1, and perhaps 255:1 (observed ratio 274:1). In following generations some plants from crosses which showed 15:1 in $F_2$ give ratios of 3:1, and others again 15:1. In a red-grained × white-grained wheat, which presented the ratio of 63:1 in $F_2$, some plants in $F_3$ gave again the ratio of 63:1, some 15:1, and some 3:1, thus confirming the author's conclusion as to the manner in which the ratios 15:1 and 63:1 arise, and showing them to be typically Mendelian. The ligula of oats was absent in only one variety used in the experiments. This crossed with numerous other varieties gave ratios 3:1, 15:1, 63:1, and in one case apparently 255:1 (actually 274:1), in different crosses. He concludes that his results prove the correctness of the presence and absence hypothesis, and that not a single fact among his crosses is opposed to the "purity" of the gametes. He also, like BAUR, would explain the inheritance of certain apparently fluctuating characters as due to Mendelian splitting of units having similar functions.

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[17] BALLS, L., Some cytological aspects of cotton breeding. Ann. Rep. Amer. Breeders' Assoc. **5**:16–28. 1909.

[18] SUTTON, ARTHUR W., Brassica crosses. Jour. Linn. Soc. Bot. **38**:338–349. *pls. 12.* 1909.

[19] NILSSON-EHLE, H., Einige Ergebnisse von Kreuzungen bei Hafer und Weizen. Botaniska Notiser 257–294. 1908.

———, Kreuzungsuntersuchungen an Hafer und Weizen. pp. 122. 1909. Lund: Hakan Ohlssons Buchdruckerei.

EAST[20] finds that dent and flint corns differ from one another in a considerable series of correlated characters, and that these combinations of characters are maintained when these types are bred with the sugar corns. Although the flint or starch character of the grains is not then visible, breeding tests show that one or the other of these is latent, so that there is a "flint" series of sugar corns and a "starch" series.

So far as evidence goes at the present time, the Mendelian method of behavior is most clearly present in crosses between the most nearly related forms, and shows the most decided tendency to break down in the crosses between more distantly related things. For this reason all studies of the behavior of species-hybrids become of the greatest importance. HURST[21] has made a survey of orchid hybrids with special reference to the inheritance of albinism, and finds the phenomena so similar to those already worked out in sweet peas and stocks that he is convinced that they present typical Mendelian segregation. LOCK[22] gives a report on some species crosses of the genus Nicotiana. This is only a preliminary report and many points remain to be cleared up He finds that the second generation of some of these crosses shows a wide range of distinct types, which he believes can be analyzed on the same basis as the sweet peas and stocks have been. Color of pollen and of corolla, and form of corolla tube (bulged or funnelform) showed typical segregation. In many characters pertaining to general habit, leaf form, etc., segregation was not present or only doubtfully. LOCK suggests the possibility that "true-breeding" hybrids may result from the failure of any but homozygous combinations, this idea being made possible by the fact that very often the fertility of such hybrids is very low, so that but a small percentage of successful seeds is produced. This matter of non-splitting hybrids between species has also been presented by BURBANK,[23] who points out that this presents a method of production of new species, probably more important than usually supposed. Although several of the instances mentioned by BURBANK have not been sufficiently tested, there can be little doubt that the species-hybrids in Rubus present cases of this kind. Upon these exceptional situations the chief attention of experimenters should be concentrated.

Another hopeful direction for research that is being taken up in several quarters is that of making analyses to determine the exact nature of the unit characters. Only in this way can we hope to discover the nature of the character-producing genes. There is a growing sentiment that all hereditary phenomena must rest in last analyses upon a chemical basis. DARBISHIRE[24] has made a careful examination of the starch grains of round and wrinkled peas in pure-bred strains and in several generations of their hybrids. He finds that there are several uncorrelated features of these starch grains which result in the hybrids having some of the characteristics of the starch grains of both the parents, thus tending to obscure the fact that the segregation of the starch characters is perfect.

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[20] EAST, E. M., A note on the inheritance in sweet corn. Science N. S. **29**:465–467. 1909.

[21] HURST, C. C., Inheritance of albinism in orchids. Gardeners' Chronicle. Feb. 6, 1909.

[22] LOCK, R. H., A preliminary survey of species crosses in the genus Nicotiana from the Mendelian standpoint. Ann. Roy. Bot. Gard. Peradeniya **4**:195–227. *pls. 12.* 1909.

[23] BURBANK, L., Another mode of species-forming. Ann. Rep. Amer. Breeders' Assoc. **5**:4–41. 1909; also, Pop. Sci. Monthly 264–266. Sept. 1909.

Miss WHELDALE[25] has studied the floral pigments of a large number of species, devoting her attention most intently to the anthocyan series, but also including a discussion of xanthein, xanthin, and carotin. A useful summary is given of the studies of others upon the chemical composition of these compounds, and a large number of observations from her own analyses are presented, the general result being to show that there is a very large number of different pigments having a common fundamental structure which pass under each of these several names. From these analyses and from experience in cross-breeding she concludes that at least two features are necessary to the production of the anthocyan color: the one a colorless aromatic chromogen of the flavone series, the other an oxidizing agent which she believes to be a ferment. The details of Miss WHELDALE'S methods of analysis and the lengthy list of literature will prove of great value to students who desire to go into these more intimate problems of genetics.

A similar work from the animal side has been attempted by RIDDLE,[26] with respect to the melanin compounds, though the author presents no work of his own, simply bringing together in an instructive way the more recent results of investigations in this field. One unfortunate feature of RIDDLE'S work is his unfamiliarity with the Mendelian work from the experimental point of view. He thinks that he has proved the utter fallacy of the entire body of Mendelian teaching, and that he has demonstrated the continuity of the so-called unit characters, a statement which contravenes the experience of all investigators who have studied the behavior of pigment characters in actual breeding. No epigenetic hypothesis as yet gives the slightest hope of enabling such predictions as are successfully made continually by workers with the unit character conception.—GEORGE H. SHULL.

**Perception of light.**—HABERLANDT[27] attempts to strengthen his theory of light perception by plants, especially on the physiological side, acknowledging

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[24] DARBISHIRE, A. D., On the result of crossing round with wrinkled peas, with especial reference to their starch grains. Proc. Roy. Soc. London B **80**:122–135. 1908.

[25] WHELDALE, MISS M., The colors and pigments of flowers, with special reference to genetics. Proc. Roy. Soc. London B **81**:44–60. 1909.

———, On the nature of anthocyanin. Proc. Cambridge Phil. Soc. **15**:137–168. 1909.

[26] RIDDLE, O., Our knowledge of melanin color formation and its bearing on the Mendelian description of heredity. Biol. Bull. **16**:316–351. 1909.

[27] HABERLANDT, G., Zur Physiologie der Lichtsinnesorgane der Laubblätter. Jahrb. Wiss. Bot. **46**:377–417. 1909.